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SOLAR OBSERVATIONS

[Meteorological Research Division, EDGAR W. WOOLARD in charge]

SOLAR RADIATION OBSERVATIONS, OCTOBER 1939

By CHARLES M. LENNAHAN

Measurements of solar radiant energy received at the surface of the earth are made at nine stations maintained by the Weather Bureau, and at ten cooperating stations maintained by other institutions. The intensity of the total radiation from sun and sky on a horizontal surface is continuously recorded (from sunrise to sunset) at all these stations by self-registering instruments; pyrheliometric measurements of the intensity of direct solar radiation at normal incidence are made at frequent intervals on clear days at three Weather Bureau stations (Washington, D. C., Madison, Wis., Lincoln, Nebr.) and at the Blue Hill Observatory at Harvard University. Occasional observations of sky polarization are taken at the Weather Bureau stations at Washington and Madison.

The geographic coordinates of the stations, and descriptions of the instrumental equipment, station exposures, and methods of observation, together with summaries of the data, obtained up to the end of 1936, will be found in the MONTHLY WEATHER REVIEW, December 1937, pp. 415 to 441; further descriptions of instruments and methods are given in Weather Bureau Circular Q.

Table 1 contains the measurements of the intensity of direct solar radiation at normal incidence, with means and their departures from normal (means based on less than 3 values are in parentheses). At Madison and Lincoln the observations are made with the Marvin pyrheliometer; at Washington and Blue Hill they are obtained with a recording thermopile, checked by observations with a Marvin pyrheliometer at Washington and with a Smithsonian silver disk pyrheliometer at Blue Hill. The table also gives vapor pressures at 7:30 a. m. and at 1:30 p. m. (75th meridian time).

Table 2 contains the average amounts of radiation received daily on a horizontal surface from both sun and sky during each week, then departures from normal and the accumulated departures since the beginning of the year. The values at most of the stations are obtained from the records of the Eppley pyrheliometer recording on either a microammeter or a potentiometer.

Direct radiation intensities averaged below normal at Washington, Lincoln, Madison, and Blue Hill.

Total solar and sky radiation was above normal at all stations except Friday Harbor and Newport. Data for five of the regular reporting stations are not included because for various reasons the data were not available. These data will be published as soon as they are available.

Polarization observations made at Madison, Wis., during the past 4 months are summarized as follows:

Seven observations in July averaged 57.8 with a maximum of 62 on the 31st, both of which were below normal. Eight observations in August averaged 61.0, which was above normal; the maximum of 68 on the 24th was just normal. Six observations in September averaged 59.2 with a maximum of 69 on the 5th, both of which were below normal. Four observations in October averaged 68.5, which was above normal; the maximum of 70 on the 23rd was normal.

TABLE 1.—*Solar radiation intensities during October 1939*

[Gram-calories per minute per square centimeter of normal surface]

WASHINGTON, D. C.

Date	Sun's zenith distance: 7:30 a. m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	1:33 p. m.
	75th mer. time	Air mass: A. M.					P. M.				75th mer. time
	e	5.0	4.0	3.0	2.0	*1.0	2.0	3.0	4.0	5.0	e.
1939	*mm.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mm.*
Oct. 7	9.83			1.00	1.12						10.21
Oct. 9	13.61				1.00						15.65
Oct. 10	14.10				1.00						11.81
Oct. 15	4.75				1.28						3.00
Oct. 18	3.15			1.14	1.29						2.87
Oct. 19	6.50			.72	.91		0.88				8.81
Oct. 20	9.14			.69	.90						10.21
Means				.89	1.07		.88				
Departures				−.07	−.06		−.24				

LINCOLN, NEBR.

Oct. 2	4.37						1.14				6.50
Oct. 3	4.95	0.64	0.75	0.87	1.02		0.78	0.43	0.29		7.04
Oct. 5	6.50	.90	1.02	1.16	1.31	1.49	1.26	1.02	.81	0.64	8.18
Oct. 6	6.50	.85	.94	1.04	1.12	1.33	1.22	1.01	.86	.74	5.36
Oct. 10	4.95	1.03	1.13	1.26	1.43	1.58	1.40	1.21	1.07	.95	6.27
Oct. 11	5.56	.92	1.04	1.19							5.16
Oct. 12	4.57				1.25						4.17
Oct. 14	3.00	.81	1.02	1.20	1.35						4.37
Oct. 16	3.30				1.05						3.63
Oct. 17	2.87	.78	.86		1.23						3.81
Oct. 18	5.56	.77	.90	1.06	1.25		.96	.48	.33		7.04
Oct. 19	4.75	.82	.94	1.11	1.27		1.30	1.14	.98	.86	6.50
Oct. 20	6.76						1.25				6.02
Oct. 23	5.16	.82	.94	1.10	1.27		1.33	1.12	.92	.73	6.50
Oct. 25	6.27	.61	.71	.85	1.10		1.10	.87	.71	.58	9.14
Oct. 28	2.62	.89	1.04	1.13	1.40						4.37
Oct. 30	3.00						1.46	1.32	1.18	1.05	2.62
Oct. 31	2.36				1.45			1.27	1.12	1.00	4.17
Means		.82	.94	1.09	1.25	1.47	1.20	.99	.83	.82	
Departures		−.01	+.01	0.00	−.03	−.01	−.05	−.08	−.11	−.01	

TABLE 1.—*Solar radiation intensities during October 1939*—Continued

MADISON, WIS.

Date	Sun's zenith distance: 7:30 a. m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	1:30 p. m.
	75th mer. time	Air mass: A. M.					P. M.				75th mer. time
	e	5.0	4.0	3.0	2.0	*1.0	2.0	3.0	4.0	5.0	e.
1939	*mm.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mm.*
Oct. 2	5.16			.76	1.19	1.45	1.14				4.75
Oct. 4	7.04		0.40	.66							8.81
Oct. 5	11.38			.47	1.16	1.48	1.19				7.57
Oct. 6	7.57			.95	1.28	1.46	1.25	0.92			7.57
Oct. 11	5.79				1.22	1.50	1.19				4.57
Oct. 12	4.57		1.01								3.63
Oct. 17	3.15						1.25				3.15
Oct. 20	5.56				1.14						5.16
Oct. 23	5.56						1.31				5.56
Means				.70	.71	1.20	1.47	1.22	.92		
Departures				−.22	−.33	0.00	+.03	+.02	−.10		

BLUE HILL, MASS.

Oct. 5	9.6	0.83			1.24		1.01				11.1
Oct. 7	9.6		0.72	0.88	1.20	1.21					8.2
Oct. 8	8.2	.82	.95	1.13							8.8
Oct. 10	11.1		.38	.55	.83				0.55	0.40	14.3
Oct. 11	10.7						1.25		0.90	.74	.64	7.9
Oct. 13	5.6	.77	.90	1.02	1.16	1.30	1.10	.93	.80	.71	5.2
Oct. 14	7.9								.95	.84	7.9
Oct. 15	2.6	.94	1.04	1.16	1.30	1.38	1.32	1.16	1.05	.94	2.8
Oct. 16	2.6	.96	1.06	1.17	1.28	1.32	1.25	1.08	.95	.82	3.6
Oct. 17	4.6	.38	.49	.60	.80						5.6
Oct. 18	1.8	.93	1.02	1.14	1.27		1.27	1.10	.98	.90	1.7
Oct. 19	5.6					1.01	.92	.77	.64	.48	6.3
Oct. 21	8.2	.27	.36	.48							9.9
Oct. 23	4.6	.93	1.03	1.11							3.3
Oct. 24	1.8	.94	1.04	1.13	1.29	1.36	1.30	1.13	1.00	.92	1.9
Oct. 28	14.3								.96	.89	11.1
Oct. 29	2.4	1.01	1.10	1.21	1.35	1.37	1.32	1.17	1.06	.95	3.6
Oct. 30	4.0	.92	1.00	1.11							5.4
Means		.81	.85	.98	1.17	1.28	1.19	1.03	.88	.77	
Departures		−.09	−.11	−.11	−.06	−.08	−.01	+.01	−.03	.00	

*Extrapolated.

TABLE 2.—*Average daily totals of solar rediation (direct + diffuse) received on a horizontal surface*

Week beginning—	Wash-ington	Madison	Lincoln	Chicago	New York	Fresno	Cam-bridge	Fair-banks	La Jolla	Albu-querque	River-side	San Juan	Friday Harbor	New-port
	Gram-calories per square centimeter													
	col.	*col.*	*col.*	*col.*	*col.*	*col.*	*col.*	*col.*	*col.*	*col.*	*col.*	*col.*	*col.*	*col.*
Oct. 1	247	385	380	388	238	361	213	98	419	524	370	590	229	218
Oct. 8	378	232	312	258	293	453	276	139	457	522	435	573	264	340
Oct. 15	410	292	354	294	343	393	321	81	407	510	403	548	174	354
Oct. 22	265	198	305	180	184	392	191	64	373	478	346	393	146	316
	Departures of daily totals from normals													
Oct. 1	−82	+106	+37	+134	−46	−66		−17	+20		−9	+64	−30	−85
Oct. 8	+70	−14	+6	+37	+25	+48		+47	+75		+59	+67	+25	+31
Oct. 15	+122	+70	+55	+92	+116	+17		+10	+38		+50	+77	−23	+65
Oct. 22	+3	−9	+23	+6	−8	+28		+3	+54		−11	−60	−8	−31
	Accumulated departures since Jan. 1													
	+17,206	+11,571	+7,490	+18,543	+6,753	+441		+1,085	+4,452		−4,604	+9,427	+5,936	+2,457